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ABSTRACT

This study examined the language of teachers and children during small group instruction in two cognitively oriented preschools. A total of 22 small group instruction sessions were videofilmed in each preschool. Lesson relevant utterances from the 44 videotapes were coded for grammatical and cognitive variables. In an examination of five specific verbal contingencies, all involving the use of questions, frequency data were analyzed using a lag-one sequential analysis procedure. Findings indicated that no dependency existed between teachers' open-form questions and children's verbal reference to a self-performed mental operation in both programs. However, significant dependencies did exist between (1) the posing of questions by teachers and children's verbal responses in both programs; (2) children's questions to classmates and an immediate peer response in one program; (3) teachers' process questions and children's verbal reference to a self-performed mental operation in both programs; and (4) teacher's closed-form questions and children's verbal reference to a self-performed mental operation in one program. The effectiveness or ineffectiveness of various questions is discussed in terms of the different instructional procedures employed in the two preschool programs. Implications for teachers are pointed out. (Author/RH)

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DEPENDENCIES BETWEEN TEACHER-CHILD AND CHILD-CHILD CONTINGENT VERBAL BEHAVIORS IN TWO PRESCHOOL PROGRAMS

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Abstract

This study examined the language of teachers and children during small group instruction in two cognitively oriented preschools. Twenty-two small group instruction sessions were videofilmed in each preschool. Lesson relevant utterances from the 44 videotapes were coded for grammatical and cognitive variables. In order to examine five specific verbal contingencies, all involving the use of questions, frequency data were analyzed using a lag-one sequential analysis procedure. It was shown that (1) significant dependencies existed between (a) the posing of questions by teachers and children's verbal responses in both programs; (b) children's questions to classmates and an immediate peer response in one program; (c) teacher's process questions and children's verbal reference to a self-performed mental operation in both programs; and (d) teacher's closed-form questions and children's verbal reference to a self-performed mental operation in one program. It was also shown that (2) no dependency existed between teacher's open-form questions and children's verbal reference to a self-performed mental operation in both programs. The effectivness or noneffectiveness of various questions are discussed in terms of the different instructional procedures employed in the two preschool programs, and implications for teachers are suggested.

Dependencies Between Teacher-Child and Child-Child Contingent Verbal Behaviors in Two Preschool Programs

The study reported here is the second part of a comprehensive study of naturally occurring classroom language produced by children and teachers in two preschool settings. The first part of the study focused on an examination of the types and extents of verbalizations employed by children and teachers during small group instruction. The results of that study are reported in Lawton and Powell (1987).

Reported here are the results of an examination of patterns of verbal dependencies between children and teachers and between children themselves during small group instruction sessions in an Ausubelian and a Piagetian preschool program.

Two Preschool Programs

It is only possible in this paper to provide a brief description of the two preschool programs. Detailed descriptions of the Ausubelian program can be found in Lawton, Hooper, Saunders, and Roth (1984), and in Lawton (1987a and b). Descriptions of the Piagetian program can be found in Lawton et. al. (1984) and in Ershler, McAllister, and Saunders (1977).

The Ausubelian Program

The teaching method employed in the Ausubelian program is based on Ausubel's theory of subsumption learning (Ausubel, Novak, & Hanesian, 1978). The sequence of instruction begins with the teacher presenting a superordinate subject matter concept, or a high-order information processing skill (in terms of concrete operations as described by Piaget), to children in the form of an advance organizer lesson. When learned, the superordinate concepts (content) and high order skills (process) form a

potentially meaningful set of "anchoring ideas" under which subsequently learned related subordinate subject matter concepts and skills may be subsumed.

Advance organizer (AO) lessons are presented to small groups of four or five children. The teacher presents one or more related superordinate concepts or high order skills using a variety of methods believed to be interesting to young children. Children's attention is focused on the defining properties of general concepts or high order skills, and each concept or skill is exemplified, using as many concrete exemplars as is considered necessary and appropriate. Exemplars are presented using picture books, films, a flannel board, real objects or illustrations of them, and through stories and the usual verbal give-and-take of small group sessions. Teachers carefully describe and explain the properties of general concepts or high order skills and question the children to determine the extent of their learning. Children are actively involved in the manipulation of objects, in making statements and asking questions about the concepts and skills they are learning, and in game-like activities.

Each AO lesson lasts approximately 15 minutes and is immediately followed by a set of related learning activities (RA). At this time, games and tasks involving interesting materials are provided for the children's use. A separate set of different, though related, materials may be provided for each child's individual use, or the entire small group of children may be involved in one or more game-like activity. These activities provide children with examples of subordinate concepts or skills related to the previously presented general concepts or high order skills. The content of each AO and RA form a hierarchy of related

superordinate to subordinate concepts, and particular information. Learning is expected to occur by progressive differentiation from the superordinate concepts provided by the AO lesson to the subordinate concepts and particular detail provided by the related activities. During RA, there is less direction for learning provided by the teacher. However, there is still considerable interaction between teacher and children. As part of the formative evaluation process, teachers are more likely to ask questions of children during the RA than during the AO lesson.

The Piagetian Program

The implications of Piaget's theory of development for preschool education have been variously interpreted (Copple, Sigel, & Saunders, 1979: Ershler et. al., 1977; Forman & Kuschner, 1977; Hohmann, Banet, & Weikert, 1979; Kamii & DeVries, 1977, 1978). In the case of this Piagetian program, the emphasis was placed on the child as an active learner, one who acts upon information and incorporates the results of those actions into a framework of knowledge. The interactive process of learning was believed to be facilitated through the child's exploration of a learning environment in which the child is free to manipulate, discover, and invent. In general, the Piagetian teachers endorsed indirect teaching strategies. They preferred to question, suggest, prompt, or model, and to encourage peer interaction, rather than teach via direct verbal instruction. A great deal of importance is placed on the use of indirect and direct-open questions by teachers as a method of prompting and guiding children's exploration.

Piagetian small group sessions consisted of four or five children and one teacher. These sessions, like their Ausubelian counterpart, were

comprised of two components—a time-of-coming-together and also a time for children's exploration of learning materials. In this program, however, the exploration phase was more likely to occur first, followed by the group experience.

In both programs, as explained, teachers and children were expected to employ considerable classroom language.

Language Use in the Classroom

Of particular interest to this study were the dependencies that were expected to exist between teacher and children (or child) and between children when using questions. The possible influence of teacher questioning strategies on the learner's thinking and reasoning has been recognized for centuries. In the early 1960's, Taba devised a multiple coding scheme (Taba & Elzey, 1964) which, when applied to classroom language data, made it possible to evaluate the impact of the teacher's verbalizations on children's levels of thinking. From the results of a study using this coding scheme, Taba concluded that, "Questions can serve to lift the level of thought in the learning process" (Taba, 1967, p. 122). Concern had also been registered that teachers predominantly focused on the lowest levels of thinking when asking questions by requesting children mainly to recall specific information (Crump, 1970; Hunkins, 1972; Sanders, 1966; Zimmerman & Bergan, 1971). Crump (1970) identified eight systems of hierarchical classification of questions identifying low and high-level questions associated with varying levels of cognition.

In 1976, Kearsley provided a comprehensive taxonomy of questions in which questions were classified into direct and indirect categories. Indirect questions are actually statements which contain an embedded

partial interrogative phrase and, like questions, elicit a response (e.g. "I wonder how that works?"). Direct questions may be open or closed. Direct-open questions, often referred to as wh- questions, elicit responses from a nearly infinite set of possibilities whereas direct-closed questions are answered from alternatives explicitly or implicitly provided within the question itself. Direct-closed questions are subdivided into questions which require a yes or no reply and questions which specify alternatives from which a response may be chosen (e.g."Will you need the red chip or the blue one?"). This question classification scheme, refined and extended for operational use in the early childhood classroom, was employed when designing an observational instrument for the present study. (See Table 2).

Studies of the effects of teacher question-asking on young children's thinking and reasoning have indicated that: (1) the classroom speech of children differs as a function of the teacher's style of verbal interaction (Smothergill, Olson and Moore (1971); (2) teachers using a process-oriented curriculum, compared to teachers focusing primarily on content, asked more high-level questions requiring perception than low-level questions requiring recall (Zimmerman & Bergan, 1971), though children's intellectual performance was not reported; (3) when a teacher varied the use of high and low level questions as requested, children significantly increased in their ability to generate alternative solutions to problems and to classify when exposed to high-level questions (Turner, 1980); and (4) children's performance varies according to the complexity level of questions posed from those asking for matching (e.g. naming objects), through selective analysis of experience (e.g. noting properties of objects), reordering experiences (e.g. temporal sequencing of events),

to reasoning about experience (e.g. explaining causal relationships), though performance was also influenced by the age of the child (Blank, Rose, & Berlin, 1978).

It has been reported that classroom conversations can be extended by the use of questions and that the probability of a "next question" is higher for teacher than for child initiated conversations (Mishler, 1975). The response to a teacher's question is likely to be evaluated by the teacher rather than merely acknowledged, as in ordinary non-classroom conversation (Mehan, 1979). The difference between question-answer sequences followed by evaluation and question-answer sequences followed by acknowledgement can also be viewed in terms of posing known-answer questions as opposed to information-seeking questions. Since teachers must evaluate children's progress, they frequently employ known-answer questions (Mehan, 1979.)

Sigel and Saunders (1979), from a Piagetian perspective of the organization of classroom learning, have recommended the use of open questions (information-seeking) requiring the child to deal with nonobservable objects and events and time or space discrepancies. It is expected that representational thinking will be exercised and enhanced as the child responds to questions which are open in form.

HYPOTHESES

For the present study, an examination was made of five specific contingencies of classroom verbal interactions when using questions. Those contingencies are: 1) Teacher's questions (any type) immediately followed by a child's verbal response; 2) Children's questions (any type) immediately followed by a peer verbal response; 3-5) Any one of three specific types of teacher's questions (process questions referring to

information processing skills; direct-open questions which provide no clues as to an appropriate response; and direct-closed questions which provide alternatives from which an appropriate reply is selected) immediately followed by a child's verbalized mental operation (information processing skill). (For further clarification, refer to Table 2).

Hypotheses associated with these contingencies were developed as follows:

1. Teacher's questions will be followed by children's verbal responses.
2. Children's questions addressed to peers will be followed by verbal responses from peers.
3. Teacher's process questions will be followed by children's verbalized mental operations.
4. Compared to teacher's closed questions, teacher's open questions will be followed more often by children's verbalized mental operations.

METHOD

Subjects

Children were enrolled in each program according to parental choice and on a first-come, first-enrolled basis. However, an attempt was made to achieve mixed ethnic groups. Although it cannot be claimed that the total preschool group was a random sample of prospective preschoolers, it is likely that children in these two programs were like most children of that age from similar backgrounds.

Of the eighteen children enrolled in the Ausubelian program and seventeen in the Piagetian program, ten children from each program were selected at random to participate in the study. The children were from

middle and upper-middle class families and of mixed ethnic origin. Characteristics of both groups are presented in Table 1. It was determined that the two sample

(Table 1)

groups did not differ from their peers in each program or from each other according to chronological age or by verbal intelligence as measured by the Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 1981).

Eight female teachers participated in the study, four in each program. These teachers were the head teacher, one assistant teacher, and two student teachers, one per semester.

Procedure

For each preschool program, 22 small group instructional sessions were videotaped by the first author of this paper from late September to early May during one school year. The length of each videotape varied between 22 and 30 minutes (M=28.8 minutes). As far as possible, videotaping was evenly spaced by taping 11 sessions per program per semester. Thus, a total of 44 small group sessions of approximately 29 minutes each were videotaped. Since each small group numbered five children, and ten children had been drawn from both programs, each "lesson" was taught twice. For each program, therefore, the 22 videotaped sessions represented eleven planned "lessons".

An examination of the videotaped lessons indicates that the Piagetian lessons included learning experiences in representation, transformations, the relationship of objects moving in space, classification, conservation, formulating predictions, the need people have for one another in terms of goods and services, and the quantification of linear space. Ausubelian program lessons included learning experiences in classification,

conservation, sequencing of events, number concepts, and living things. It was estimated that each group of children were exposed to both content and process concepts to about the same extent. However, it was also clear from observations that the teaching methods employed within the two programs differed and reflected the stated philosophy and objectives of each program. All videotaping took place in a specially selected classroom regularly used for small group sessions by both preschool programs.

Variables

Variables of particular interest to this investigation were selected from among a larger array of dichotomous variables in the data set of a comprehensive preschool classroom language study (Lawton & Fowell, 1987). For that study, every lesson-relevant utterance was determined to be:

1) a question (indirect, direct-open, direct-closed or reminding) or statement (indirect, direct or reminding).
2) pertaining to content (subject matter concepts) or pertaining to process (information processing skills e.g. ordering, classification, conservation, and problem solving).
3) general (reference to superordinate concepts or high level skills) or specific (reference to particular instance or example).

A more detailed description of these variables is provided on Table 2. The reader will want, in particular, to note the descriptions of direct-open and direct-closed questions and process utterances.

(Table 2)

In addition, each process utterance was designated either as talk about process or as a performed operation. An example pertaining to the

process of classification follows:

Teacher: "Where does this piece go?"

This is a question about classification of an object upon a matrix board, but the teacher herself has not classified the object. This is talk about process.

Child: "It goes (places object) right here."

The child has correctly classified the object upon the matrix and has referred verbally to that placement. An operation has been performed.

The variables of particular interest to the present investigation of contingent verbal behaviors and the hypothesis associated with each variable are shown below. Each contingency consists of a set of two verbal behaviors and, for each, the first behavior is a question and the second is a response to that question.

Questions

1. Employed by teachers
   - A. any type (Hypothesis 1)
   - B. process (Hypothesis 3)
   - C. direct-open (Hypothesis 4)
   - D. direct-closed (Hypothesis 4)
2. Employed by children

   any type (Hypothesis 2)

Responses

1. Child's verbal reply (any type) which:
   - A. immediately followed the teacher's question and was addressed to the teacher (Hypothesis 1) or

B. immediately followed a classmate's question and was addressed to that classmate (Hypothesis 2).

2. Child's verbalized performed operation which immediately followed a teacher's question and was addressed to the teacher (Hypotheses 3 & 4).

Coding

Verbal utterances were coded by the first author of this paper using a code sheet providing a record of events indicating a sequence of verbal interactions (Lytton, 1971), as illustrated in Table 3.

(Table 3)

The vertical space allocated to one verbalization was referred to as a frame. Each frame provided space in which to code a single teacher utterance (upper half) and a single child utterance (lower half). Each half-frame allowed the coding of a verbalization as either a question or a statement, as referring to process or content, and as either general or specific in level of specificity. Beneath each teacher frame was written the initial of the child(ren) to whom the utterance was addressed (recipient), and beneath each child frame, the initials of both child speaker and recipient were placed. Only verbalizations related to the lesson topic were coded.

Since small groups (five children and one teacher) were being observed and children tend to move around, decisions about who spoke and to whom were determined with great care. A teacher's or child's face could nearly always be seen and voices distinguished, but when this was not the case, the coders relied on contextual cues for making speaker-recipient decisions (e.g. Wilkinson, Clevenger, & Dollaghan, 1981).

The code categories for questions have already been described. Further details pertaining to operational definitions of questions and examples of each type of question and other utterance variables can be found in Fowell (1983).

Reliability

Two subsidiary coders were trained to code verbalizations from the videotapes. Five videotapes were coded by each of these coders. Two types of reliability were assessed. First, the percent agreement between coders for each individual verbalization variable within the verbal sequence was determined. Second, because this study was concerned with the examination of verbal contingencies by means of sequential lag procedures, it was necessary to assess sequential reliability. Therefore, the percent agreement between coders on all utterances in the order of their actual occurrence was obtained.

Mean percent agreement for each verbalization variable was computed for four of the ten double-coded tapes, using the formula:

$$\frac{\text{agreement}}{\text{agreement + disagreement}} \times 100$$

where agreement + disagreement=N coded verbalizations. Percent agreement for all questions, in general, was 96.2%.

To compute percent agreement between coders for sequential coding, all ten double-coded tapes were used (five per subsidiary coder). Since an error for each utterance could occur in any one of eight possible ways (question or statement; process or content; process talk or operation performed; general or specific; speaker and recipient; plus a missed verbalization by either the primary or subsidiary coder), the formula employed was:

$$\frac{\text{agreement}}{\text{agreement} + .75\ (\text{disagreement})} \times 100.$$

Comparing subsidiary code work to that of the primary coder, percent agreement for sequential utterances was 72% for the first subsidiary coder and 77% for the second coder.

It was decided to have coders work directly from the videotapes, coding from what they actually heard spoken. This procedure likely contributed to the lower-than-desired percent agreement between coders. Researchers who obtain satisfactory reliability values for observational studies often prepare transcripts before code work begins (e.g. Blank & Franklin, 1980; Cherry, 1975; Fraser & Roberts, 1975; Garvey, 1974; Mishler, 1975; Moerk, 1975; Price, Hess, & Dickson, 1980). When coders work from transcripts, disagreement about actual events or behaviors cannot occur; instead, disagreements tend to reflect individual variation with respect to code decisions, as intended.

Validity

The concern for validity is whether the data collected are typical of language in these two preschools. The use of videotaping can be expected to increase the likelihood of obtaining valid observations (Genishi, 1982). Since children in this study, once settled, seemed to forget the video camera and operator, it can be assumed that data collected of verbal interactions between teacher and children are, at least, internally valid.

RESULTS

To examine verbal dependencies, whole session frequencies for selected questions-response contingencies were obtained using a lag crosstabulation procedure. Lagged frequencies for contingent behaviors are shown in Table 4.

(Table 4)

The frequencies shown in each of the crosstabulations in Table 4 represent lag one events summed across 22 sessions in both preschools. Lag one refers to the first verbal behavior following a specified criterion behavior. The criterion event is labeled "question" and the subsequent behavior, "response".

Sackett (1979) proposed a method for analyzing relationships among behaviors in observational data known as lag sequential analysis. He reasoned that if a "behavior-B-follows-behavior-A" relationship occurs at chance levels, its observed frequency should be equal to the overall (marginal) probability that B will occur at all. If, on the other hand, the conditional probability that "B-follows-A" is significantly greater than the probability that B will appear overall, then a dependency has been shown to exist. Sackett suggested testing the difference between observed and expected lag probabilities by means of a binomial test employing the Z_s statistic. If the test statistic is equal to or greater than $\pm$ 1.96, then the difference between the observed and expected probabilities is significant at the .05 level, and a dependency has been established.

However, Serlin (1981) has indicated that the Z_s statistic employed by Sackett is not a standard normal variable and therefore cannot be used as a test for determining the significance of an association between observed and expected possibilities. Similarly, Allison and Liker (1982) criticized the Z_s statistic employed by Sackett, and they proposed the use of a Z_1 statistic which has a standard normal distribution. With reference to a 2x2 table in which first behaviors are designated as A and $\bar{A}$ and second behaviors, as B and $\bar{B}$, then

$$Z_1 = \frac{P_{B|A} - P_B}{\sqrt{\frac{P_B\,(1 - P_B)\,(1 - P_A)}{(n - k)\,P_A}}}$$

where $P_{B|A}$ represents the conditional proportion, P_B represents the unconditional proportion, and k refers to the number of lagged time units (in this case, k=1). This statistic was used with the present data to test the null hypothesis that the probability of B-given-A is equal to, or less than, the probability that B would occur at all for specified contingency variables. For each case, the Z_1 statistic was compared to 2.054, the approximate value for a one-tailed test at the .02 alpha level. Results are shown in Table 5.

(Table 5)

Employing the Z_1 statistic, it was determined that a significant dependency existed between the posing of questions by teachers and related responses by children such that Z_1 =19.86 in the Ausubelian program and Z_1 =13.00 in the Piagetian program (for both, $p<.02$). A significant dependency was shown to exist between children's questions to classmates and related peer responses (Z_1 =2.84, $p<.02$) in the Piagetian program, but not in the Ausubelian program (Z_1 =-0.31, $p>.02$). Teachers' process questions were significantly related to children's verbal references to a mental operation in both programs (Ausubelian program: Z_1 =22.22, $p<.02$; Piagetian program: Z_1 =17.73, p,<.02). For both programs, teachers' use of direct-open questions had no significant relationship with children's responses in terms of self-performed mental operations. However, the association between teachers' use of direct-closed questions and children's verbalized mental operations was a significant one in the

Ausubelian program (Z_1=3.50, $p<.02$), but not in the Piagetian program (Z_1 =1.07, $p>.02$).

According to Allison and Liker (1982), it is useful to obtain a measure of the strength of an association between two contingent variables in order to make comparisons between subjects or treatments. They advocate the use of β which is the logarithm of the cross-product ratio such that if the observed frequencies in a 2x2 table are designated as

$$\begin{matrix} f_1 & f_2 \\ f_3 & f_4 \end{matrix}$$

then $\beta = \log_e (f_1 f_4)/(f_2 f_3)$. Unlike the Z_1 statistic, β is invariant to the marginal totals of a contingency table, has a range from minus to plus infinity, and is 0 when the two variables are independent. Beta measures have been used, for example, to assess contingencies of mothers' and infants' responsiveness to one another's vocalizations (Stevenson, VerHoeve, Leavitt, & Roach, 1983).

Beta measures were determined for each set of variables and for each preschool and the results are shown in Table 5. The null hypothesis that the measure of association β is the same in each of two groups can be tested by finding the difference between the two β measures and dividing by the standard error of the difference (Allison & Liker, 1982). The result is a test statistic designated as Z_2 by Fienberg (1980), as shown:

$$Z_2 = \frac{\beta_1 - \beta_2}{\sqrt{\sum_i \frac{1}{fi}}}$$

For each difference between β measures for the two preschool programs, the Z_2 statistic was determined and compared to 2.326 for a

two-tailed test at the .02 alpha level. As shown in Table 5, the likelihood of teachers' questions being followed by children's related responses was greater in the Ausubelian program than in the Piagetian program (Z_2 = 2.79, $p<.02$). Between program comparisons for the remaining dependencies, shown in Table 5, were nonsignificant.

DISCUSSION

Data supported the expectation that teacher questions would be immediately followed by a child's related response and that this was more likely to be the case in the Ausubelian program. This finding is not surprising given the greater emphasis on direct verbal instruction in the Ausubelian program where questioning played an important part in evaluating the effectivenss of AO lessons. In both AO lessons and the subsequent RA's, but especially during the latter, Ausubelian program teachers asked questions, expecting an answer. It appears that children in this program may have developed an expectation that an effort should be made to provide timely responses to teachers' questions. Piagetian teachers were more apt to pose questions intended to provoke curiosity or stimulate interest. Questions such as "How could you use this?" were not necessarily intended to elicit an immediate response.

Post hoc analysis indicated that significant task (group time versus activities) differences appeared only in the case of this dependency (Hypothesis 1), and they appeared in both programs (Ausubelian program: for AO group lesson, β =1.81 and for related activities, β =1.31; Piagetian program: for the time-of-coming-together, β =1.53 and for free exploration time (activities), β=0.81. Z_2 =3.21 for the Ausubelian program and 3.82 for the Piagetian program). In both programs, questions posed at group time appear to have received multiple responses.

Children's attention was usually focused on a particular event. Under these conditions, children were more apt to respond to questions addressed to them. During actvities, however, children's attention was diverted in two ways. First, children were frequently absorbed in learning materials and second, they were more apt to verbally interact with peers during activities compared to group time.

A second and more important finding is the strong support from the data that, for both groups, teachers' questions pertaining to process (ordering, classifying, labeling etc.) would be immediately followed by a child's response referring to a self-performed mental operation (Hypothesis 3). This finding is consistent with, and lends support to, the contention that the much larger proportional use of process questions by Ausubelian program teachers, compared to Piagetian teachers (Lawton & Fowell, 1987), was associated with the greater evidence of verbalized mental operations by the Ausubelian group children.

No positive association existed between teachers' use of direct-open questions and children's verbalized mental operations (Hypothesis 4). In fact, for the Ausubelian group, these contingent behaviors were shown, by a post hoc test, to be significantly and negatively related. In the event that the first behavior of a contingency tends to extinguish the second behavior, the binomial test statistic should be negative. Thus, it appears that Ausubelian program teachers' use of direct-open questions tended to surpress children's verbal references to performed mental operations. In contrast, for both classrooms, teachers' direct-closed questions did tend to be followed by a response indicating a performed mental operation, though this association was significant only for the Ausubelian group.

If, as in the present study, the contingent relationship of interest is in the forward direction, that is, in the behavior which occurs immediately following a specified event, then use of the Z_1 test statistic provides information about sufficiency (Watson & Hayes, 1981). Thus, it appears that teacher process questions were sufficient to elicit children's verbalized mental operations in both classrooms, whereas teachers' direct-closed questions were effective in the same sense only in the Ausubelian program. In addition, based on β measures alone, it can be seen that teachers' use of process questions were more effective than use of direct-closed questions in eliciting children's verbal reference to process operations. A question which remains to be addressed is the extent to which teachers' process questions were also direct and closed in form.

The fact that direct-closed questions appeared to be more effective than direct-open questions in eliciting children's references to mental operations is, in itself, an interesting finding. That such questions were more effective for this purpose in the Ausubelian program suggests that question use and effectiveness during interaction is related to the curriculum. Leaving aside the selection and organization of learning materials, important elements of a curriculum are objectives, the selection and organization of learning experiences (including the form of instruction and the role of the child as learner), and evaluation procedures. The manner in which a curriculum is put into effect will create expectations regarding instructional and learning roles, and about teacher-child interaction, peculiar to that curriculum. In the case of the two programs examined here, both shared an important objective, that

of facilitating children's development of mental operations, vis-a-vis concrete operations as described by Piaget. The videotaped instructional sessions show that the number and type of learning opportunities for children to engage in mental operations were very similar in both programs. It appears therefore, that the instructional procedure and organization of learning activities in the Ausubelian program was more effective in promoting such thinking than that in the Piagetian program.

There is other evidence to support the above conclusion. Results from a three year longitudinal study of instructional outcomes in these two programs indicate that, compared to children in the Piagetian program, children in the Ausubelian program made significantly greater improvement in the understanding and use of logical concepts, namely, classification, ordering, and conservation (Lawton, et.al., 1984; Lawton, 1987b). Thus, there is evidence to suggest that, following AO and RA instruction, Ausubelian program children's ability to exhibit logical thinking was improved.

The child question-child response dependency existed only in the Piagetian group. This finding seems consistent with the Piagetian curriculum where there was a greater emphasis on, and encouragement of, peer interaction. It is noted that even though this dependency was established for the Piagetian, but not the Ausubelian program, the difference between the two association measures was shown to be nonsignificant. Nonetheless, the negative association between children's questions and peer responses in the Ausubelian program is puzzling since there was an absence of evidence from the videotapes to suggest that child-child verbal interaction was deliberately discouraged or suppressed. It is likely that Ausubelian program teachers placed a greater value on

teacher-child verbal interaction and promoted such interactions more than child-child interactions. They participated in conversations between children, rather than allowing talk to continue among children without adult contributions. This being so, it is possible that peer responses to children's questions may not have occurred as the first verbal interchange, but subsequent to a teacher's intervening response. Peer responses to a child's questions, therefore, may have occured more frequently in the Ausubelian program at lag two or lag three, and if so, were not included in the data. It should be noted that children in both programs were more apt to respond to a teacher's questions than to questions asked by peers.

These results do have implications for classroom teachers. It would appear that if teachers desire to provide opportunities for children to engage in and practice process operations, one effective teaching strategy may be to ask questions pertaining to process. Findings from this study also suggest that, at least, the effectiveness of open, compare to closed, questions needs further evaluation. Finally, It seems fair to say that the effectiveness of closed-form questions will depend, to some extent, on the structure of the curriculum in which they are employed.

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Table 1

Subject-Characteristics by Program

Program	N	Sex M	Sex F	Mean Age	Range	PPVT (Mean Raw Score)	SD
Ausubelian	10	4	6	4 yrs 2 mo	3 yrs 8 mo to 4 yrs 8 mo	42.2	14.6
Piagetian	10	5	5	4 yrs 1 mo	3 yrs 5 mo to 4 yrs 8 mo	35.7	15.9

PPVT: Peabody Picture Vocabulary Test

Table 2. Categories of Verbalizations

All Utterances Are Either Questions Or Statements

CATEGORY	SUB-CATEGORY	DESCRIPTION
Questions: (Kearsley, 1975)	Indirect Questions (IQ)	1. A question containing an embedded partial interrogative phrase: e.g., "I wonder why it turns green?" 2. A question containing a missing word: e.g., "We can make green from blue and _____?"
	Direct Closed Questions (DCQ)	1. Explicit closure. Questions answered with "yes" or "no"; (e.g. "Is Max afraid?") and questions for which the answers are provided within the question itself (e.g. "Is it rough or smooth?") 2. Implicit closure. Questions closed, verbally or by gesture, to a limited set of materials (e.g. "Which of these chairs belongs to the Mama Bear?").
	Direct Open Questions (DOQ)	These questions provide no cues as to appropriate responses: e.g., "When we are packed, how shall we go to the beach?"
	Reminding Questions (RQ)	Used by teachers to prompt children's recall or recognition of previously encountered objects or events: e.g., "Remember when we visited the lake and it was frozen?"
Statements: (Mann, 1974)	Direct Statements (DS)	e.g., "An orange can roll like a ball."; "Look at the wheels go round.";
	Indirect Statements (IS)	e.g., "I guess maybe we need to blow a bit lower."
	Reminding Statements (RS)	e.g., "I remember that heavy things went down (on the scale)."

That Refer to Content or Process

Content	References to subject matters concepts and facts: e.g., "Gilberto could not see the wind, but he could feel it on his face." (physical knowledge); and, "Numbers come in different shapes." (number concepts).
Process	References to information processing skills: 1. ORDERING. "First you plant the seed, then it grows into a flower." 2. CLASSIFICATION. "These (indicating one row in a matrix) are all red, and these (an intersecting column) are all Legos." 3. CONSERVATION. One of two identical amounts of liquid is paired in a different shaped container--"Do we have as much juice here as here?" 4.PROBLEM SOLVING. References to predictions (e.g. "How can I change this balloon so that it will be like it was before?"); problem solving (e.g. "How can we make it heavier?"); and cause and effect (e.g. "When I go this way (aiming pendulum), it makes the blocks go down"). 5. LABELING. References to naming a person, place, object, event, attribute, and category or set label, e.g., "The cotton is soft."; "If we put all these together, what can we call this group?"; "There are five cookies." 6. OTHER OPERATIONS. References to reading and counting, e.g., "It says yellow."; "We can count--one, two, three, and four."

And Are Either General or Specific

General	References to general concepts and high-order skills: e.g., "Numbers have a special order when we are counting."
Specific	References to particular objects and events: e.g., "Does this one come after the four?"; "What number do we call it?"

Table 3. Verbal Utterance Code Sheet

Name of Coder:_____

Tape No._____ School: A P Teacher:_____ Page:___

Date: _____ Grouptime/Activities Children:_____

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Teacher	Q																				
	S																				
	P																				
	C																				
	G																				
	S																				
	INIT																				
Child	Q																				
	S																				
	P																				
	C																				
	G																				
	S																				
	INIT																				

NOTE: Q = Question; S = Statement; P = Progress; C = Content; G = General;
S = Specify; INIT = Initials of teacher or child

Table 4

Lagged Frequencies for Contingent Behaviors: Whole Session Data

Question	Response			
	Ausubelian Program		Piagetian Program	
1. *TQ and ChR to T (Hypothesis 1)*				
	ChR	NoChR[1]	ChR	NoChR
TQ	1159	1010	779	879
2. *ChQ to Peers and Peer Response to Question (Hypothesis 2)*				
	ChR	NoChr	ChR	NoChR
ChQ to Peers	2	9	23	30
3. *T Process Q and Ch Reference to Mental Operation (Hypothesis 3)*				
	ChOp	NoChOp[2]	ChOp	NoChOp
T process Q	701	108	229	77
4. *T Direct-Open Q and Ch Reference to Mental Operation (Hypothesis 4)*				
	ChOp	NoChOp	ChOp	NoChOp
T direct-open Q	217	153	100	189
5. *T Direct-Closed Q and Ch Reference to Mental Question (Hypothesis 4)*				
	ChOp	NoChOp	ChOp	NoChOp
T direct-closed Q	536	228	117	297

1 ChR: Children's Responses;
NoChR: No Children's Responses.
2 ChOp: Children's Verbalized Mental Operations
NoChOp: No Children's Verbalized Mental Operations.
T = Teacher
Ch = Child
Q = Questions

Table 5
Associations Between Verbalizations During Small Group Instruction

Associated Variables	Related Hypotheses	Z_1	B	Z_2
1. Teacher Questions and Child Response				
Ausubelian Program	1	19.86*	1.49	2.79**
Piagetian Program		13.00*	1.16	
2. Children's Question and Peer Response to Questions				
Ausubelian Program	2	-0.31	-0.26	1.25
Piagetian Program		2.84*	0.84	
3. Teacher Process Question and Child Reference to Mental Operation				
Ausubelian Program	3	22.22*	3.22	0.02
Piagetian Program		17.73*	3.23	
4. Teacher Direct-Open Question and Child Reference to Mental Operation				
Ausubelian Program	4	-4.05	-0.52	-2.15
Piagetian Program		-0.55	-0.08	
5. Teacher Direct-Closed Question and Child Reference to Mental Operation				
Ausubelian Program	4	3.50*	0.45	1.38
Piagetian Program		1.07	0.17	

*Significant for one-tailed test at .02 alpha level.
**Significant for two-tailed test at .02 alpha level.